Full-scale Experimental Validation of Dynamic, Centrifugally Powered, Pneumatic Actuators for Active Rotor Blade Surfaces

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Purpose

The objectives this program are 1) to experimentally demonstrate a revolutionary active rotor actuation concept on a full scale rotor: centrifugally powered, pneumatic actuation for rotor blade active surfaces, 2) to compare experimental results to analytical performance predictions of pneumatic actuation, and 3) to determine the viability of pneumatic actuation of various active surface concepts through full-scale demonstration of expected performance benefits.

Background

Research over past several decades has shown that in order to achieve significant rotor performance increase, it must actively adapt, or “morph,” to the changing environment around the azimuth. Several active rotor blade surfaces have been proposed, including trailing edge flaps, Miniature Trailing Edge Effectors (MiTEs), and leading edge slats. Significant challenges to successfully implementing surface actuation with traditional motors are the existence of extremely large centrifugal forces and the negative inertial effects of installing relatively heavy actuators outboard on the blades. It would be advantageous to utilize the large centripetal acceleration created by the rotor to generate an on-blade air pressure differential for actuation, thus eliminating both the need to transmit high amounts of electrical power to the rotating frame and the need for heavy, traditional actuators that can negatively impact rotor performance. Invercon’s actuation concept is directly aligned with the objectives of NASA’s Subsonic Rotary Wing Project, having the potential to having the potential to enable more efficient flight, enhance vehicle maneuverability, allow for multi-mission vehicle configurations, reduce exterior noise, and generally enhance the competiveness of US rotary winged vehicles in the civil sector.